

Assessment of e-liquid composition

For the Queensland Parliament - Health & Environment Committee

1. Purpose

To assess the chemical composition of e-liquids that are currently in vaping products available in Queensland.

2. Scope

To analyse the chemical composition of seventeen (17) e-liquid samples currently available in the Queensland vape market.

Seven (7) e-liquid samples were sourced from Health & Environment Committee (the Committee) and ten (10) samples were sourced from state-wide compliance activities from government departments (Queensland Health and Queensland Police Service).

3. Background

E-cigarette products marketed and sold in Queensland are not assessed in relation to their quality or safety.

Public health concerns have been raised by the community and by health practitioners regarding the risks of vaping products and their aerosols. In addition to nicotine, liquids used in electronic cigarettes also contain other chemical additives which have the potential to pose serious health risks to users. E-liquids are reported to contain other chemical additives such as flavours, solvents, preservatives, and contaminants that may be harmful to health when inhaled as part of vaping.

4. Laboratory Analysis

The 17 e-liquid samples were analysed by Queensland Health Forensic and Scientific Services (QH FSS) using the available laboratory methods. Qualitative or quantitative analyses were undertaken for nicotine, prohibited substances under the Therapeutic Goods Administration's - Therapeutic Goods (Standard for Nicotine Vaping Products) (TGO 110) Order 2021 (TGO 110), and other substances of concern such as carbonyl compounds, volatile organic compounds (VOCs), pesticides/fungicides/herbicides, and heavy metals.

The detection limit for the analytes was determined by QHFSS based on its current analytical capability. This may vary from the compliance limits established for the substances.

5. Results and Discussion

The 17 samples were analyzed for nicotine and other substances of concern such as carbonyl compounds, VOCs, pesticides, and heavy metals, and eight substances that are prohibited ingredients in vapes under the TGO 110.

E-liquids are also known to contain other chemical additives (flavourings and preservatives) and contaminants that have the potential to pose a serious health risk to vape users. These chemical additives and contaminants typically include various carbonyl compounds, VOCs, and heavy metals.

The results of the 17 samples are discussed below.

5.1 Nicotine

Nicotine was found in all e-liquid samples, as shown in Table 1. The nicotine content ranged from trace levels (<200 mg/kg) to 47,000 mg/kg.

Under Queensland's *Medicines and Poisons Act 2019*, vaping devices containing nicotine may only be obtained at a pharmacy under the prescription of a medical practitioner. Such devices may contain up to 100 mg/ml (100,000 mg/kg) of nicotine. Vaping products which contain nicotine and are sourced from other retailers are illegal under the *Medicines and Poisons Act 2019*. As these samples were NOT obtained through a pharmacy via a prescription, **nicotine should not have been present in any samples.**

The capacity of e-cigarettes to deliver nicotine and other harmful chemicals into the body varies widely, ranging from very low to levels like that of cigarettes, depending on product characteristics, user inhalation behaviour, and nicotine solution concentration.

The health risks of nicotine include neurological, cardiovascular, respiratory (impaired lung function), renal, and reproductive health effects. In some cases, high levels of exposure can lead to death. Young children, adolescents, pregnant and breastfeeding mothers, and the elderly are considered the most vulnerable to nicotine exposure. According to the World Health Organisation, nicotine itself is not a carcinogen, however, it may function as a "tumor promoter". Nicotine seems involved in fundamental aspects of the biology of malignant diseases, and neurodegeneration.

4.2 Prohibited ingredients

There are eight chemical compounds listed as prohibited ingredients under the TGO 110. These include 2,3-pentanedione, acetoin, benzaldehyde, cinnamaldehyde, diacetyl, diethylene glycol, dl-alpha-tocopheryl acetate (Vit E), and ethylene glycol. The compliance limit set under the TGO 110 is less than 10 parts per million (ppm).

The laboratory analysis in **Table 2** revealed that none of the seventeen (17) samples contained prohibited ingredients above the laboratory limit of reporting (LoR) or limit of detection of 2000ppm. This limit is significantly higher (x200) than the compliance limit set under the TGO 110.

Further analysis would need to be undertaken to ascertain that the samples do not contain prohibited ingredients above the detection limit set under TGO 110.

It should be noted that using a different analytical method, which is used to assess carbonyls, benzaldehyde (carbonyl) was detected in two of the samples, at 28ppm and 66ppm (note 1 mg/kg = 1ppm). Benzaldehyde is a prohibited ingredient under TGO 110 with a compliance limit of <10 ppm, set by TGO 110.

There are known health risks associated with inhaling these prohibited ingredients identified in the TGO 110. These include irreversible lung damage; respiratory failure; toxicity of the brain, heart, and kidneys; and impairment of the immune cell function.

Table 1 - Nicotine

| Lab Analysis (Limit of Reporting: 200 mg/kg) | IGET Bar Strawberry Watermelon Ice | Vorteke Melon | IGET Bar Strawberry Lemon Ice | IGET Legend Passionfruit Watermelon Ice | IGET Bar Grape Ice | IGET Bar Kiwi Pineapple Ice | IGET Legend Blueberry Blackberry Ice | HQD Cuvie Plus - Strawberry Watermelon | HQD Cuvie Plus – Passionfruit |
|---|------------------------------------|---------------|-------------------------------|---|--------------------|-----------------------------|--------------------------------------|--|-------------------------------|
| Nicotine | Present | Present | Present | Present | Present | Present | Present | Present | Present |
| Concentration (mg/kg) | 43,000 | <200 | 45,000 | 47,000 | 47,000 | 45,000 | 44,000 | 38,000 | 44,000 |

| Lab Analysis (Limit of Reporting: 200 mg/kg) | IGET Bar - Peach Ice - 3500 puffs | IGET Bar - Blackberry Ice - 3500 puffs | IGET XXL - Lush Ice - 1800 puffs | IGET Goat - Cherry Ice - 5000 puffs | Gunnpod Meta - Grape Ice - 4500 puffs | Gunnpod Wave - Summer Breeze - 3500 puffs | IGET Mega - Strawberry Banana Ice - 3000 puffs | Waka Smash - Apple surge - 6000 puffs |
|---|-----------------------------------|--|----------------------------------|-------------------------------------|---------------------------------------|---|--|---------------------------------------|
| Nicotine | Present | Present | Present | Present | Present | Present | Present | Present |
| Concentration (mg/kg) | 37,000 | 33,000 | <200 | 28,000 | 30,000 | 12,000 | 35,000 | 30,000 |

Table 2 – Prohibited substances under TGO 110

| Vaping liquid Samples tested (Limit of Reporting 2000mg/kg except for Vitamin E acetate 50 mg/kg)) | TGO110 - Prohibited Substances | | | | | | | |
|---|--------------------------------|----------------|---------|--------------|----------------|-------------------|-----------------|-------------------|
| | 2,4-Butadione | 2,3-Pentadione | Acetoin | Benzaldehyde | Cinnamaldehyde | Vitamin E acetate | Ethylene glycol | Diethylene glycol |
| IGET Bar Strawberry Watermelon Ice | < LOR | < LOR | < LOR | < LOR | < LOR | < LOR | < LOR | < LOR |
| Vorteke Melon | < LOR | < LOR | < LOR | < LOR | < LOR | < LOR | < LOR | < LOR |
| IGET Bar Strawberry Lemon Ice | < LOR | < LOR | < LOR | < LOR | < LOR | < LOR | < LOR | < LOR |
| IGET Legend Passionfruit Watermelon Ice | < LOR | < LOR | < LOR | < LOR | < LOR | < LOR | < LOR | < LOR |
| IGET Bar Grape Ice | < LOR | < LOR | < LOR | < LOR | < LOR | < LOR | < LOR | < LOR |
| IGET Bar Kiwi Pineapple Ice | < LOR | < LOR | < LOR | < LOR | < LOR | < LOR | < LOR | < LOR |
| IGET Legend Blueberry Blackberry Ice | < LOR | < LOR | < LOR | < LOR | < LOR | < LOR | < LOR | < LOR |
| HQD Cuvie Plus - Strawberry Watermelon | < LOR | < LOR | < LOR | < LOR | < LOR | < LOR | < LOR | < LOR |
| HQD Cuvie Plus – Passionfruit | < LOR | < LOR | < LOR | < LOR | < LOR | < LOR | < LOR | < LOR |
| IGET Bar - Peach Ice - 3500 puffs | < LOR | < LOR | < LOR | < LOR | < LOR | < LOR | < LOR | < LOR |
| IGET Bar - Blackberry Ice - 3500 puffs | < LOR | < LOR | < LOR | < LOR | < LOR | < LOR | < LOR | < LOR |
| IGET XXL - Lush Ice - 1800 puffs | < LOR | < LOR | < LOR | < LOR | < LOR | < LOR | < LOR | < LOR |
| IGET Goat - Cherry Ice - 5000 puffs | < LOR | < LOR | < LOR | < LOR | < LOR | < LOR | < LOR | < LOR |
| Gunnpod Meta - Grape Ice - 4500 puffs | < LOR | < LOR | < LOR | < LOR | < LOR | < LOR | < LOR | < LOR |
| Gunnpod Wave - Summer Breeze - 3500 puffs | < LOR | < LOR | < LOR | < LOR | < LOR | < LOR | < LOR | < LOR |
| IGET Mega - Strawberry Banana Ice - 3000 puffs | < LOR | < LOR | < LOR | < LOR | < LOR | < LOR | < LOR | < LOR |
| Waka Smash - Apple surge - 6000 puffs | < LOR | < LOR | < LOR | < LOR | < LOR | < LOR | < LOR | < LOR |

5.3 Other Chemicals of Concern

5.3.1 Carbonyl compounds

All 17 samples of e-liquids were found to contain carbonyl compounds. All samples contained at least two carbonyl compounds (formaldehyde and acetaldehyde) and 16 samples contained acrolein.

Carbonyl compounds are considered irritants of the mucosal tissue of the lungs. Some of these compounds are potentially harmful to health. For example, formaldehyde is classified as a Group 1 human carcinogen by the International Agency for Research on Cancer, and acetaldehyde is classified as possibly carcinogenic to humans (Group 2B); while acrolein causes irritation of the nasal cavity and damages the lining of the lungs.

5.3.2 Volatile Organic Compounds

VOCs are a class of organic compound chemicals (usually found in gaseous form) that are typically used and produced in the manufacture of paints, pharmaceuticals, and refrigerants.

All 17 samples contained various VOCs. Five VOCs are common to all 17 samples: propylene glycol, glycerin, 2-isopropyl-N,2,3-trimethylbutanamide, benzoic acid, and 3-hexene-1-ol.

Propylene glycol and glycerin are the main components of e-liquids. They are known to be hazardous when inhaled. Heating propylene glycol and glycerin in e-cigarettes produces lung disease hazards and inhaling these compounds makes the lungs vulnerable to infections. Breathing aerosolised propylene glycol can affect the risk of asthma development.

While some of the VOCs detected are not known to pose health risks, many of these have been flagged for critical health concerns. For example, methyl anthranilate (found in three products) and ethyl propanoate (found in one product) are suspected carcinogens and either a mutagen, skin sensitiser or toxic to reproduction. Further, neomenthol (found in 7 products) and ethyl lactate have also been suspected to be toxic to reproduction.

5.3.3 Heavy Metals

All samples contained between five to fifteen heavy metals. Arsenic and zinc were detected in all samples. Other toxic heavy metals identified include lead, mercury, nickel, chromium, antimony, aluminium, iron, nickel, barium, manganese, copper, strontium, and vanadium.

A number of these heavy metals are known to be carcinogenic, mutagenic, toxic to reproduction and development, and cause neurological anomalies. Arsenic and nickel are carcinogens, while chromium and nickel are linked to respiratory diseases. Manganese, lead, and mercury are known to cause neurological and developmental defects. Barium may cause kidney problems, while vanadium may be toxic to the respiratory system.

6. Summary of Results

Several chemical compounds detected in e-liquids tested as part of this analysis have been reported to pose serious health risks to vape users. The analysis identified that:

- All 17 samples of e-liquid products analysed contained nicotine. The nicotine content ranged from trace levels (<200 mg/kg) to 47,000 mg/kg.

- None of the 17 samples analysed recorded prohibited ingredients above the laboratory detection limit of 2000 ppm (or 50 ppm for vitamin E acetate). The detection limit employed by QHFSS is significantly higher (x 200) than the compliance limit set under the TGO 110 which is less than 10 ppm.
- Using a different analysis method, benzaldehyde, which is a prohibited ingredient under TGO 110, was detected in two of the samples, at 28 ppm and 66 ppm which is above the limit set by TGO 110 (<10 ppm).
- All 17 samples contained various VOCs. Five (5) VOCs are common to all 17 samples.
- All samples contained between five 5 to 15 heavy metals. A number of these heavy metals are considered toxic when inhaled including arsenic and zinc, which were detected in all samples.